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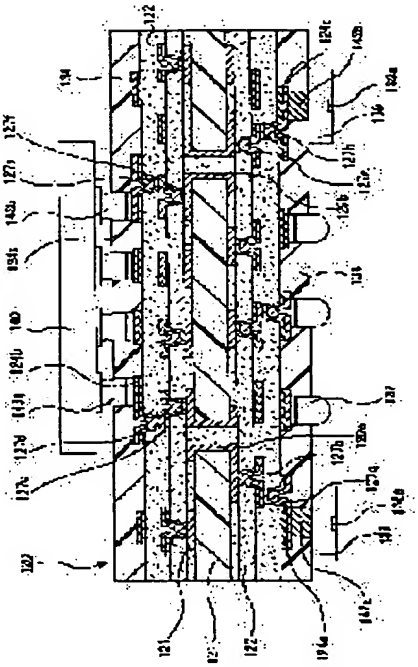
(54) BOARD FOR MOUNTING IC CHIP

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a board for mounting IC chips where the distance between an IC chip and optical components is short, and electric signal transmission reliability is excellent in a component for optical communication where the IC chip and the optical component are integrated.
SOLUTION: In the board for mounting IC chips, a conductive circuit and an interlayer resin insulating layer are laminated and formed on both the surfaces of the board. On the board, a light receiving device and a light-emitting device are mounted on one surface of the board so that light reception and transmission sections can be exposed.



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CLAIMS

[Claim(s)]
[Claim 1] both sides of a substrate -- a conductor -- the substrate for IC chip mounting which a circuit and the resin insulating layer between layers are the substrates for IC chip mounting by which laminating formation was carried out, and is characterized by mounting the photo detector and the light emitting device in the front face of 1 of said substrate for IC chip mounting so that a light sensing portion and a light-emitting part may be exposed, respectively.
[Claim 2] both sides of a substrate -- a conductor -- the substrate for IC chip mounting which a circuit and the resin insulating layer between layers are the substrates for IC chip mounting by which laminating formation was carried out, and is characterized by building in or containing the photo detector and the light emitting device so that a light sensing portion and a light-emitting part may be exposed to the field side of 1 of said substrate for IC chip mounting, respectively.
[Claim 3] both sides of a substrate -- a conductor -- the substrate for IC chip mounting which a circuit and the resin insulating layer between layers are the substrates for IC chip mounting by which laminating formation was carried out, and is characterized by to secure the optical path which connects the light sensing portion and the lightwave signal of said photo detector, and the optical path which connects the light-emitting part and the lightwave signal of said light emitting device while a photo detector and a light emitting device are laid under the field side of 1 of said substrate for IC chip mounting.
[Claim 4] Said optical path is a substrate for IC chip mounting according to claim 3 which is opening for optical paths.
[Claim 5] The substrate for IC chip mounting given in any 1 of claims 1-4 by which a solder resist layer is formed in the outermost layer by the side of the field of 1 of said substrate for IC chip mounting, and the solder bump is formed in said solder resist layer.
[Claim 6] the conductor said whose substrate was pinched -- the conductor which between circuits was connected through the through hole and sandwiched said resin insulating layer between layers -- the substrate for IC chip mounting given in any 1 of claims 1-5 to which between circuits is connected through the Bahia hall.
[Claim 7] Said photo detector is a package substrate given in any 1 of claims 1-6 which are what can make solder connection.
[Claim 8] Said light emitting device is a package substrate given in any 1 of claims 1-6 which are what can make solder connection.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the substrate for IC chip mounting.
[0002] In recent years, attentions have gathered for the optical fiber focusing on the communication link field. In especially IT (information technology) field, the communication technology which used the optical fiber for maintenance of the high-speed Internet network is needed. In the communication system using the optical fiber which has the descriptions, such as 1 low loss, 2 high bandwidth, 3 narrow diameters and a light weight, no 4 guiding, and 5 saving resources, and has this description, compared with the communication system using the conventional metallic cable, the number of repeaters can be reduced sharply, construction and maintenance become easy, and an optical fiber can attain economization of communication system, and high-reliability-ization.
[0003] Moreover, since an optical fiber can multiplex the light of the wavelength from which not only the light of one wavelength but many differ to coincidence with one optical fiber, it can realize the transmission line of the large capacity which can respond to various applications, and can respond to image service etc.
[0004] Then, in network communication, such as such the Internet, using the optical communication using an optical fiber not only for the communication link of a backbone but for the communication link with a backbone and terminal equipments (a personal computer, mobile one, game, etc.) and the communication link of terminal equipments is proposed.
[0005] Thus, when using optical communication for the communication link with a backbone and a terminal equipment etc., in order for IC which performs information (signal) processing in a terminal equipment to operate with an electrical signal, it is necessary to attach the equipment (henceforth light/electric transducer) which changes the lightwave signal and electrical signal of optical -> electric transducer, electric -> phototransducer, etc. into a terminal equipment. So, in the conventional terminal equipment, for example, optics, such as a package substrate which mounted IC chip, a photo detector which processes a lightwave signal, and a light emitting device, etc. were mounted separately, electric wiring and optical waveguide were connected to these, and a signal transmission and signal processing were performed.
[0006]
[Problem(s) to be Solved by the Invention] In such a conventional terminal equipment, since IC mounting package substrate and the optic were mounted separately, the whole equipment became large and had become the factor which bars the miniaturization of a terminal equipment. Moreover, in the conventional terminal equipment, since the distance of IC mounting package substrate and an optic was separated, electric wiring distance is long and it was easy to generate the signal error by a cross talk noise etc. at the time of a signal transmission.
[0007]
[Means for Solving the Problem] Then, while attaining the optical communication which is excellent in connection dependability, as a result of examining wholeheartedly the substrate for IC chip mounting which can be contributed to the miniaturization of a terminal equipment, by mounting various optics in the substrate for IC chip mounting, this invention persons hit on an idea for the technical problem mentioned above to be solvable, and completed the substrate for IC chip mounting of this invention which consists of the following configuration.
[0008] namely, the substrate for IC chip mounting of the first this invention — both sides of a substrate — a conductor — a circuit and the resin insulating layer between layers are the substrates for IC chip mounting by which laminating formation was carried out, and in the front face of 1 of the above-mentioned substrate for IC chip mounting, it is characterized by mounting the photo detector and the light emitting device so that a light sensing portion and a light-emitting part may be exposed, respectively.
[0009] the substrate for IC chip mounting of the second this invention — both sides of a substrate — a

conductor — a circuit and the resin insulating layer between layers are the substrates for IC chip mounting by which laminating formation was carried out, and it is characterized by building in or containing the photo detector and the light emitting device at the field side of 1 of the above-mentioned substrate for IC chip mounting so that a light sensing portion and a light-emitting part may be exposed, respectively.

[0010] the substrate of the third this invention for IC chip mounting — both sides of a substrate — a conductor — a circuit and the resin insulating layer between layers are the substrates for IC chip mounting by which laminating formation was carried out, and while a photo detector and a light emitting device are laid underground, it is characterized by to be secured the optical path which connects the light sensing portion and the lightwave signal of the above-mentioned photo detector, and the optical path which connects the light-emitting part and the lightwave signal of the above-mentioned light emitting device at the field side of 1 of the above-mentioned substrate for IC chip mounting. Moreover, as for the above-mentioned optical path in the substrate for IC chip mounting of the third this invention, it is desirable that it is opening for optical paths.

[0011] In the substrate for IC chip mounting of the first - the third this invention, it is desirable to form a solder resist layer in the outermost layer by the side of the field of 1 of the above-mentioned substrate for IC chip mounting, and to form the solder bump in the above-mentioned solder resist layer. In addition, in the substrate for IC chip mounting of the first - the third this invention, the solder resist layer may be formed and does not need to be formed.

[0012] moreover, the conductor whose above-mentioned substrate was pinched in the substrate for IC chip mounting of the first - the third this invention — the conductor which between circuits was connected through the through hole and sandwiched the above-mentioned resin insulating layer between layers — it is desirable to connect between circuits through the Bahia hall.

[0013] Moreover, as for the above-mentioned photo detector and the above-mentioned light emitting device, in the substrate for IC chip mounting of the first - the third this invention, it is desirable that it is what can make solder connection. Electrical connection is carried out while being mounted in the above-mentioned substrate for IC chip mounting with the solder pad which is ** flip chip die parts and was prepared in the same side as a light-receiving side and a luminescence side, for example as the photo detector which can make [above-mentioned] solder connection, and a light emitting device. ** That by which electrical connection is carried out while being mounted in the above-mentioned substrate for IC chip mounting with the solder pad which is flip chip die parts and was prepared in the opposite side of a light-receiving side and a luminescence side. ** That by which electrical connection is carried out by carrying out wire bonding to the pad for wire bonding which was mounted in the above-mentioned substrate for IC chip mounting with the solder pad which is wire-bonding die parts and was prepared in the same side as a light-receiving side and a luminescence side, and was prepared in the opposite side of a light-receiving side and a luminescence side. ** It is wire-bonding die parts, and it is mounted in the above-mentioned substrate for IC chip mounting with the solder pad prepared in the opposite side of a light-receiving side and a luminescence side, and that by which electrical connection is carried out is mentioned by carrying out wire bonding to the pad for wire bonding prepared in the same side as a light-receiving side and a luminescence side. In these, it is desirable that they are the above-mentioned ** or **. While being able to double the location of a photo detector and a light emitting device (a light sensing portion and light-emitting part) with the light guide lines (optical waveguide etc.) of external substrates, such as a mother board, with a sufficient precision using the self-alignment effectiveness which solder has and excelling in the positioning accuracy of a photo detector and a light emitting device, since wire bonding is unnecessary, it can mount in the substrate for IC chip mounting easily. In addition, as the photo detector mounted in the substrate for IC chip mounting of this invention, and a light emitting device, although mentioned to the above-mentioned ** - **, it is not necessary to be any one sort, and two or more sorts may exist [what was mentioned to the above-mentioned ** - **].

[0014]

[Embodiment of the Invention] First, the substrate for IC chip mounting of the first this invention is explained. the substrate for IC chip mounting of the first this invention — both sides of a substrate — a conductor — a circuit and the resin insulating layer between layers are the substrates for IC chip mounting by which laminating formation was carried out, and in the front face of 1 of the above-mentioned substrate for IC chip mounting, it is characterized by mounting the photo detector and the light emitting device so that a light sensing portion and a light-emitting part may be exposed, respectively.

[0015] With the substrate for IC chip mounting of the first this invention, since the photo detector and the light emitting device are mounted on the surface of the substrate, when IC chip is mounted in this substrate, the distance of IC chip and an optic is short and it excels in the dependability of electrical signal transmission. Moreover, in the substrate for IC chip mounting of this invention which mounted IC chip, since electronic parts and an optic required for optical communication can be unified, it can contribute to the miniaturization of the

terminal equipment for optical communication.

[0016] Moreover, the solder resist layer is formed in the outermost layer of the side in which the above-mentioned photo detector etc. is mounted in the substrate for IC chip mounting of the first this invention. When the solder bump is formed in the above-mentioned solder resist layer The above-mentioned substrate for IC chip mounting can be connected with an external substrate through a solder bump, and the above-mentioned substrate for IC chip mounting can be arranged to a position in this case according to the self-alignment operation which solder has.

[0017] In addition, in order that, as for a self-alignment operation, a solder resist layer may crawl solder, solder says the operation to which it is going to exist in a stable configuration by near the center of opening for solder bump formation with the fluidity which self has at the time of reflow processing. Though location gap has occurred to both in front of a reflow in case the above-mentioned substrate for IC chip mounting is connected to an external substrate through the above-mentioned solder bump when this self-alignment operation is used, the above-mentioned substrate for IC chip mounting can move at the time of a reflow, and this substrate for IC chip mounting can be attached in the exact location on an external substrate. Therefore, if the mounting position of the photo detector mounted in the above-mentioned substrate for IC chip mounting or a light emitting device is exact when transmitting a lightwave signal through the photo detector and light emitting device which were mounted in the above-mentioned substrate for IC chip mounting, and the optics (optical waveguide etc.) mounted in the above-mentioned external substrate, an exact lightwave signal can be transmitted between the above-mentioned substrate for IC chip mounting, and the above-mentioned external substrate.

[0018] In the substrate for IC chip mounting of the first this invention, the photo detector and the light emitting device are mounted so that a light sensing portion and a light-emitting part may be exposed to the front face of 1, respectively. As the above-mentioned photo detector, PD (photodiode), APD (avalanche photodiode), etc. are mentioned, for example. What is necessary is just to use these properly suitably in consideration of the configuration of the above-mentioned substrate for IC chip mounting, demand characteristics, etc. Si, germanium, InGaAs, etc. are mentioned as an ingredient of the above-mentioned photo detector. In these, a point to InGaAs which is excellent in light-receiving sensibility is desirable.

[0019] As the above-mentioned light emitting device, LD (semiconductor laser), DFB-LD (distribution feedback mold-semiconductor laser), LED (light emitting diode), etc. are mentioned, for example. What is necessary is just to use these properly suitably in consideration of a configuration, demand characteristics, etc. of the above-mentioned substrate for IC chip mounting.

[0020] As an ingredient of the above-mentioned light emitting device, a gallium, arsenic and the compound (GaAsP) of Lynn, a gallium, aluminum and the compound (GaAlAs) of arsenic, a gallium and the compound (GaAs) of arsenic, an indium, a gallium and the compound (InGaAs) of arsenic, an indium, a gallium, arsenic, the compound (InGaAsP) of Lynn, etc. are mentioned. That what is necessary is just to use these properly in consideration of communication link wavelength (the range of 0.6-1.6 micrometers), when communication link wavelength is 0.85-micrometer band, GaAlAs can be used, and in the case of 1.3-micrometer band or 1.55-micrometer band, communication link wavelength can use InGaAs and InGaAsP. In addition, what is marketed as an optical element can be used as the above-mentioned photo detector and the above-mentioned light emitting device, and that whose die length of one side of the field which has a light sensing portion and a light-emitting part is about 2-15mm is desirable as the magnitude.

[0021] Hereafter, the operation gestalt of the substrate for IC chip mounting of the first this invention is explained, referring to a drawing. Drawing 1 is the sectional view showing typically 1 operation gestalt of the substrate for IC chip mounting of the first this invention. In addition, drawing 1 shows the substrate for IC chip mounting in the condition that IC chip was mounted.

[0022] it is shown in drawing 1 — as — the mounting substrate 120 for IC chip — both sides of a substrate 121 — a conductor — the conductor with which laminating formation was carried out and the substrate 121 of the resin insulating layer [a circuit 124 (124a-124d) and] 122 between layers was pinched — the conductor which sandwiched the resin insulating layer 122 between layers between circuits — the through hole 129 (129a, 129b) and the Bahia hall 127 (127a-127h) connect electrically between circuits, respectively. Moreover, the solder resist layer 134 is formed in the outermost layer. Moreover, in the front face of 1 of the mounting substrate 120 for IC chip, the solder bump 137 is formed in the solder resist layer of the side in which a photo detector 138 and a light emitting device 139 are mounted, in addition the photo detector 138 grade is mounted, and the IC chip 140 is mounted in other front faces of the mounting substrate 120 for IC chip through the solder connection 143 (143a, 143b) so that light sensing portion 138a and light-emitting part 139a may be exposed, respectively.

[0023] In the substrate 120 for IC chip mounting which consists of such a configuration The lightwave signal sent from the outside through an optical fiber, optical waveguide (not shown), etc. After receiving by the photo

detector 138 (light sensing portion 138a), it changes into an electrical signal by the photo detector 138. furthermore, conductive layer 142a- a conductor — circuit 124a-Bahia hall 127a and 127b-through hole 129a-Bahia hall 127c and 127d- a conductor — it will be sent to the IC chip 140 through circuit 124b-solder connection 143a.

[0024] moreover, the electrical signal sent out from the IC chip 140 — solder connection 143b- a conductor — circuit 124c-Bahia hall 127e and 127f-through hole 129b-Bahia hall 127g and 127h- a conductor — after being sent to a light emitting device 139 through 124d-conductive layer 142of circuits b, it will be changed into a lightwave signal by the light emitting device 139, and this lightwave signal will be sent to an optical fiber or optical waveguide from a light emitting device 139 (light-emitting part 139a).

[0025] In the substrate for IC chip mounting of the first this invention, in the photo detector and light emitting device which were mounted in the location near IC chip, since light / electrical signal conversion is performed, the transmission distance of an electrical signal is short, is excellent in the dependability of a signal transmission, and can respond to a high-speed communication link more.

[0026] Moreover, in the substrate 120 for IC chip mounting, since the solder bump 137 is formed in the solder resist layer by the side of the field of 1, as mentioned above, after the electrical signal sent out from the IC chip 140 is changed into a lightwave signal, it it is not only sent out outside, but will be sent to an external substrate through a solder bump through optical waveguide etc. Moreover, power required for making IC chip drive from the exterior of the substrate 120 for IC chip mounting can also be supplied through the solder bump 137.

[0027] Next, how to manufacture the substrate for IC chip mounting of the first this invention is explained.

(1) an insulating substrate — a start ingredient — carrying out — first — this insulating substrate top — a conductor — form a circuit. As the above-mentioned insulating substrate, a glass epoxy group plate, a polyester substrate, a polyimide substrate, a bismaleimide-triazine (BT) resin substrate, a thermosetting polyphenylene ether substrate, copper clad laminate, a RCC substrate, etc. are mentioned, for example. Moreover, ceramic substrates, such as an alumimium nitride substrate, and a silicon substrate may be used. the above — a conductor — a circuit can be formed by performing etching processing, after forming a solid conductor layer in the front face of for example, the above-mentioned insulating substrate by nonelectrolytic plating processing etc. Moreover, you may form by performing etching processing to copper clad laminate or a RCC substrate.

[0028] moreover, the conductor whose above-mentioned insulating substrate was pinched — in making connection between circuits by the through hole, after using a drill, laser, etc. for example, for the above-mentioned insulating substrate and forming a through tube, the through hole is formed by performing nonelectrolytic plating processing etc. In addition, the diameter of the above-mentioned through tube is usually 100-300 micrometers. Moreover, when a through hole is formed, it is desirable to be filled up with a resin filler in this through hole.

[0029] (2) next, the need — responding — a conductor — perform roughening formation processing on the surface of a circuit. as the above-mentioned roughening formation processing — melanism (oxidization) — the etching processing using the etching reagent containing - reduction processing, the second copper complex, and an organic-acid salt etc., processing by the Cu-nickel-P needlelike alloy plating, etc. can be mentioned. Here, when a roughening side is formed, the minimum of the average roughness of this roughening side has desirable 0.1 micrometers, and 5 micrometers of an upper limit are usually desirable. a conductor — the adhesion of a circuit and the resin insulating layer between layers, and a conductor — when the effect to the electrical signal transmission ability of a circuit etc. is taken into consideration, the minimum of the above-mentioned roughening side has more desirable 2 micrometers, and 4 micrometers of an upper limit are more desirable. In addition, before this roughening formation processing is filled up with a resin filler in a through hole, it may be performed, and it may form a roughening side also in the wall surface of a through hole. It is because the adhesion of a through hole and a resin filler improves.

[0030] (3) next, a conductor — form the resin layer which forms the resin layer which is not hardened [which some of thermosetting resin photopolymers, and thermosetting resin become from the acrylic-ized resin, these and thermoplastics, and the included resin complex] on the substrate in which the circuit was formed, or consists of thermoplastics. The resin layer which is not hardened [above-mentioned] can be formed by applying non-hardened resin by the roll coater, a curtain coating machine, etc., or carrying out thermocompression bonding of the resin film non-hardened (semi-hardening). Moreover, the resin layer which consists of the above-mentioned thermoplastics can be formed by carrying out thermocompression bonding of the resin Plastic solid fabricated on the film.

[0031] In these, the approach of carrying out thermocompression bonding of the resin film non-hardened (semi-hardening) is desirable, and sticking by pressure of a resin film can be performed for example, using a vacuum laminator etc. Moreover, although what is necessary is not to limit especially sticking-by-pressure conditions, but just to choose suitably in consideration of the presentation of a resin film etc., it is usually desirable to carry

out on a pressure 0.25 - 1.0MPa, the temperature of 40-70 degrees C, the degree of vacuum of 13-1300Pa, and about [time amount 10-120 second] conditions.

[0032] As the above-mentioned thermosetting resin, an epoxy resin, phenol resin, polyimide resin, polyester resin, a bismaleimide resin, polyolefine system resin, polyphenylene ether resin, polyphenylene resin, a fluororesin, etc. are mentioned, for example. As an example of the above-mentioned epoxy resin, novolak mold epoxy resins, such as a phenol novolak mold and a cresol novolak mold, the cycloaliphatic epoxy resin which carried out dicyclopentadiene conversion are mentioned, for example.

[0033] As the above-mentioned photopolymer, acrylic resin etc. is mentioned, for example. Moreover, the thing to which the heat-curing radical, and the methacrylic acid and acrylic acid of the above-mentioned thermosetting resin were made to acrylic--ization-react as resin which acrylic-ized some above-mentioned thermosetting resin for example, is mentioned.

[0034] As the above-mentioned thermoplastics, phenoxy resin, polyether sulfone (PES), polysulfone (PSF), polyphenylene sulfone (PPS) polyphenylene sulfide (PPES), polyphenylene ether (PPE) polyether imide (PI), etc. are mentioned, for example.

[0035] Moreover, as the above-mentioned resin complex, especially if thermosetting resin, a photopolymer (the resin which acrylic-ized some thermosetting resin is also included), and thermoplastics are included, it will not be limited, but as a concrete combination of thermosetting resin and thermoplastics, phenol resin / polyether sulfone, polyimide resin/polysulfone, an epoxy resin / polyether sulfone, an epoxy resin/phenoxy resin, etc. are mentioned, for example. Moreover, as a concrete combination of a photopolymer and thermoplastics, acrylic resin/phenoxy resin, the epoxy resin that acrylic-ized a part of epoxy group, polyether sulfone, etc. are mentioned, for example.

[0036] Moreover, as for the rate of a compounding ratio of thermosetting resin and the photopolymer in the above-mentioned resin complex, and thermoplastics, thermosetting resin or a photopolymer / thermoplastics =95 / 5 - 50/50 are desirable. It is because a high toughness value is securable, without spoiling thermal resistance.

[0037] Moreover, the above-mentioned resin layer may consist of resin layers from which it differs more than two-layer. It is that a lower layer is formed from thermosetting resin or the resin complex of a photopolymer / thermoplastics =50/50, and the upper layer is specifically formed from thermosetting resin or the resin complex of a photopolymer / thermoplastics =90/10 etc. While securing the outstanding adhesion with a substrate by making it such a configuration, the formation ease at the time of forming opening for the Bahia halls etc. at a back process is securable.

[0038] Moreover, the above-mentioned resin layer may be formed using the resin constituent for roughening side formation. The matter of fusibility is distributed to the roughening liquid which consists of at least one sort chosen from an acid, alkali, and an oxidizer into the heat-resistant-resin matrix which is not hardened [poorly soluble] to the roughening liquid which serves as the above-mentioned resin constituent for roughening side formation from at least one sort chosen from an acid, alkali, and an oxidizer. In addition, when the same time amount immersion is carried out, the word of the above "poor solubility" and "fusibility" says relatively what has an early dissolution rate as "fusibility" to the same roughening liquid for convenience, and calls "poor solubility" relatively what has a late dissolution rate to it for convenience.

[0039] In case the above-mentioned roughening liquid is used for the resin insulating layer between layers and a roughening side is formed as the above-mentioned heat-resistant-resin matrix, what can hold the configuration of a roughening side is desirable, for example, thermosetting resin, thermoplastics, these complex, etc. are mentioned. Moreover, by using a photopolymer, exposure and a development may be used for the resin insulating layer between layers, and opening for the Bahia halls may be formed.

[0040] As the above-mentioned thermosetting resin, an epoxy resin, phenol resin, polyimide resin, polyolefin resin, a fluororesin, etc. are mentioned, for example. Moreover, when sensitization-izing the above-mentioned thermosetting resin, a heat-curing radical is made to acrylic(meta)--ization-react using a methacrylic acid, an acrylic acid, etc.

[0041] As the above-mentioned epoxy resin, a cresol novolak mold epoxy resin, the bisphenol A mold epoxy resin, a bisphenol female mold epoxy resin, a phenol novolak mold epoxy resin, an alkylphenol novolak mold epoxy resin, a biphenol female mold epoxy resin, a naphthalene mold epoxy resin, a dicyclopentadiene mold epoxy resin, the epoxidation object of the condensate of phenols and the aromatic aldehyde which has a phenolic hydroxyl group, triglycidyl isocyanurate, cycloaliphatic epoxy resin, etc. are mentioned, for example. These may be used independently and may be used together two or more sorts. Thereby, it excels in thermal resistance etc.

[0042] As the above-mentioned thermoplastics, phenoxy resin, polyether sulfone, polysulfone, polyphenylene sulfone, polyphenylene sulfide, a polyphenyl ether, polyether imide, etc. are mentioned, for example. These may be used independently and may be used together two or more sorts.

[0043] It is desirable that it is at least one sort as which the matter of fusibility is chosen from an inorganic particle, a resin particle, and metal particles to the roughening liquid which consists of at least one sort chosen from the above-mentioned acid, alkali, and an oxidizer.
[0044] As the above-mentioned inorganic particle, an aluminium compound, a lime compound, a potassium compound, a magnesium compound, a silicon compound, etc. are mentioned, for example. These may be used independently and may be used together two or more sorts.
[0045] As the above-mentioned aluminium compound, as the above-mentioned lime compound, a calcium carbonate, a calcium hydroxide, etc. are mentioned, potassium carbonate etc. is mentioned, an alumina, an aluminum hydroxide, etc. are mentioned and a silica, a zeolite, etc. are mentioned [a magnesia, a dolomite basic magnesium carbonate, talc, etc. are mentioned, and] as the above-mentioned silicon compound as the above-mentioned magnesium compound as the above-mentioned potassium compound, for example. These may be used independently and may be used together two or more sorts.
[0046] Dissolution removal of the above-mentioned alumina particle can be carried out by fluoric acid, and dissolution removal of the calcium carbonate can be carried out with a hydrochloric acid. Moreover, dissolution removal of a sodium content silica or the dolomite can be carried out in an alkali water solution.
[0047] As the above-mentioned resin particle, what consists of thermosetting resin, thermoplastics, etc. is mentioned, for example. When immersed in the roughening liquid which consists of at least one sort chosen from an acid, alkali, and an oxidizer It will not be limited especially if a dissolution rate is earlier than the above-mentioned heat-resistant-resin matrix. Specifically For example, amino resin (melamine resin, a urea-resin, guanamine resin, etc.), an epoxy resin, phenol resin, phenoxy resin, polyimide resin, polyphenylene resin, polyolefin resin, a fluororesin, bismaleimide-triazine resin, etc. are mentioned. These may be used independently and may be used together two or more sorts. In addition, the above-mentioned resin particle needs to carry out hardening processing beforehand. It is because the above-mentioned resin particle will dissolve in the solvent in which a resin matrix is dissolved if it is not made to harden.
[0048] Moreover, as the above-mentioned resin particle, a rubber particle, liquid phase resin, liquid phase rubber, etc. may be used. As the above-mentioned rubber particle, acrylonitrile-butadiene rubber, polychloroprene rubber, polyisoprene rubber, acrylic rubber, multi-** system rigidity rubber, a fluororubber, polyurethane rubber, silicone rubber, ABS plastics, etc. are mentioned, for example. Moreover, for example, various denaturation polybutadiene rubbers, such as polybutadiene rubber, epoxy denaturation, urethane denaturation, and acrylonitrile (meta) denaturation, the acrylonitrile-butadiene rubber (meta) containing a carboxyl group, etc. may be used.
[0049] As the above-mentioned liquid phase resin, the non-hardened solution of the above-mentioned thermosetting resin can be used, and epoxy non-hardened oligomer, the mixed liquor of an amine system curing agent, etc. are mentioned as an example of such liquid phase resin, for example. As the above-mentioned liquid phase rubber, non-hardened solutions, such as various denaturation polybutadiene rubbers, such as the above-mentioned polybutadiene rubber, epoxy denaturation, urethane denaturation, and acrylonitrile (meta) denaturation, and acrylonitrile-butadiene rubber (meta) containing a carboxyl group, etc. can be used, for example.
[0050] To prepare the above-mentioned photopolymer constituent using the above-mentioned liquid phase resin or liquid phase rubber, a heat-resistant-resin matrix and the matter of fusibility need to dissolve and twist to homogeneity (that is, phase separation is carried out like), and need to choose these matter like. By mixing the heat-resistant-resin matrix chosen by the above-mentioned criteria and the matter of fusibility, the photopolymer constituent in the condition that the "island" of a heat-resistant-resin matrix is distributing in the "sea" of the condition which the "island" of liquid phase resin or liquid phase rubber is distributing in the "sea" of the above-mentioned heat-resistant-resin matrix, liquid phase resin, or liquid phase rubber can be prepared. And after stiffening the photopolymer constituent of such a condition, a roughening side can be formed by removing the liquid phase resin or liquid phase rubber of the "sea" or a an "island."
[0051] As the above-mentioned metal particles, gold, silver, copper, tin, zinc, stainless steel, aluminum, nickel, iron, lead, etc. are mentioned, for example. These may be used independently and may be used together two or more sorts. Moreover, the surface may be covered with resin etc. in order that the above-mentioned metal particles may secure insulation.
[0052] When two or more sorts are mixed and it uses the matter of the above-mentioned fusibility, as a combination of the matter of two sorts of fusibility to mix, the combination of a resin particle and an inorganic particle is desirable. the resin insulating layer between layers which adjustment of thermal expansion tends to plan them between poorly soluble resin, and they become from the resin constituent for roughening side formation while both of conductivity can be hurt low and can secure the insulation of the resin insulating layer between layers — a crack — not generating — the resin insulating layer between layers, and a conductor — it

is because exfoliation does not occur between circuits.
[0053] It is desirable to use an organic acid in these as an acid used as the above-mentioned roughening liquid, for example, although organic acids, such as a phosphoric acid, a hydrochloric acid, a sulfuric acid, a nitric acid, and formic acid, an acetic acid, etc. are mentioned. It is because it is hard to make the metallic conductor layer exposed from the Bahia hall corrode when roughening processing is carried out. As the above-mentioned oxidizer, it is desirable to, use the water solution of a chromic acid, chromate acid mixture, and alkaline permanganates (potassium permanganate etc.) etc. for example. Moreover, as the above-mentioned alkali, water solutions, such as a sodium hydroxide and a potassium hydroxide, are desirable.
[0054] The mean particle diameter of the matter of the above-mentioned fusibility has desirable 10 micrometers or less. Moreover, big coarse grain and mean particle diameter may use it combining a small particle relatively relatively [mean particle diameter / the mean particle diameter of 2 micrometers or less]. That is, it is combining the matter of the fusibility whose mean particle diameter's is 0.1-0.5 micrometers, and the matter of the fusibility whose mean particle diameter's is 1-2 micrometers etc.
[0055] Thus, when big coarse grain and mean particle diameter combine a small particle relatively relatively [particle / average], the dissolution residue of a thin film conductor layer can be lost, the amount of palladium catalysts under plating resist can be lessened, and a still shallower and complicated roughening side can be formed. Furthermore, by forming a complicated roughening side, even if the irregularity of a roughening side is small, the practical Peel reinforcement is maintainable. Mean particle diameter exceeds 0.8 micrometers, and that of the above-mentioned coarse grain is less than 2.0 micrometers, and, as for a particle, it is desirable for mean particle diameter to be 0.1-0.8 micrometers.
[0056] (4) Next, in forming the resin insulating layer between layers using thermosetting resin and resin complex as the ingredient, while performing hardening processing to a non-hardened resin insulating layer, form opening for the Bahia halls and consider as the resin insulating layer between layers. Moreover, at this process, a through tube may be formed if needed. As for the above-mentioned opening for the Bahia halls, forming by the lasing is desirable. Moreover, when a photopolymer is used as an ingredient of the resin insulating layer between layers, you may form by the exposure development.
[0057] Moreover, in forming the resin insulating layer between layers using thermoplastics as the ingredient, opening for the Bahia halls is formed in the resin layer which consists of thermoplastics, and it considers as the resin insulating layer between layers. In this case, opening for the Bahia halls can be formed by giving the lasing. Moreover, what is necessary is just to form this through tube by drilling, the lasing, etc., when forming a through tube at this process.
[0058] As laser used for the above-mentioned lasing, carbon dioxide gas laser, ultraviolet laser, excimer laser, etc. are mentioned, for example. In these, excimer laser and the carbon dioxide gas laser of a short pulse are desirable.
[0059] Moreover, it is desirable also in excimer laser to use the excimer laser of a hologram method. A hologram method is a method which irradiates a laser beam through a hologram, a condenser lens, a laser mask, an imprint lens, etc. at the specified substance, and much openings can be once formed in a resin film layer efficiently by exposure by using this method.
[0060] Moreover, when using carbon dioxide gas laser, as for the pulse separation, it is desirable that they are 10-4 - 10 to 8 seconds. Moreover, as for the time amount which irradiates the laser for forming opening, it is desirable that it is 10 - 500 microseconds. Moreover, much openings for the Bahia halls can be formed at once by irradiating a laser beam through an optical-system lens and a mask. By minding an optical-system lens and a mask, it is the same reinforcement and is because exposure reinforcement can irradiate the same laser beam at two or more parts. Thus, after forming opening for the Bahia halls, DESUMIA processing may be performed if needed.
[0061] (5) next, the front face of the resin insulating layer between layers including the wall of opening for the Bahia halls -- a conductor -- form a circuit. a conductor -- in forming a circuit, a thin film conductor layer is first formed in the front face of the resin insulating layer between layers. The above-mentioned thin film conductor layer can be formed by approaches, such as nonelectrolytic plating and sputtering.
[0062] As the quality of the material of the above-mentioned thin film conductor layer, copper, nickel, tin, zinc, cobalt, a thallium, lead, etc. are mentioned, for example. In these, what consists of the copper from a point, copper, and nickel which are excellent in an electrical property, economical efficiency, etc. is desirable. Moreover, as thickness of the above-mentioned thin film conductor layer, when forming a thin film conductor layer with nonelectrolytic plating, the minimum has desirable 0.3 micrometers and its 0.6 micrometers are more desirable. Moreover, the upper limit has desirable 2.0 micrometers, and is more desirable. [of 1.2 micrometers] Moreover, when forming by sputtering, 0.1-1.0 micrometers is desirable.
[0063] Moreover, a roughening side may be formed in the front face of the resin insulating layer between layers

before forming the above-mentioned thin film conductor layer. By forming a roughening side, the adhesion of the resin insulating layer between layers and a thin film conductor layer can be raised. When the resin insulating layer between layers is especially formed using the resin constituent for roughening side formation, it is desirable to form a roughening side using an acid, an oxidizer, etc.

[0064] Moreover, when a through tube is formed at the process of the above (4), in case a thin film conductor layer is formed on the resin insulating layer between layers, it is good also as a through hole by forming a thin film conductor layer also in the wall surface of a through tube.

[0065] (6) Subsequently, form plating resist on the substrate with which the thin film conductor layer was formed in the front face. After the above-mentioned plating resist sticks for example, a photosensitive dry film, it can carry out adhesion arrangement of the photo mask which consists of a glass substrate with which the plating resist pattern was drawn, and can form it by performing an exposure development.

[0066] (7) After that, perform electroplating by making a thin film conductor layer into a plating bar, and form an electroplating layer in the above-mentioned plating-resist agenesis section. As the above-mentioned electroplating, copper plating is desirable. Moreover, the thickness of the above-mentioned electroplating layer and 5-20 micrometers are desirable.

[0067] then, the thing for which the thin film conductor layer under the above-mentioned plating resist and this plating resist is removed — a conductor — a circuit (the Bahia hall is included) can be formed. What is necessary is just to perform removal of the above-mentioned thin film conductor layer using etching reagents, such as mixed liquor of a sulfuric acid and a hydrogen peroxide, sodium persulfate, ammonium persulfate, a ferric chloride, and a cupric chloride, that what is necessary is just to perform removal of the above-mentioned plating resist for example, using an alkali water solution etc. moreover, the above — a conductor — after forming a circuit, the catalyst on the resin insulating layer between layers may be removed using an acid or an oxidizer if needed. It is because the fall of an electrical property can be prevented. moreover, the method of performing etching processing, after replacing with the approach (a process (6) and (7)) of forming an electroplating layer after forming this plating resist and forming an electroplating layer the whole surface on a thin film conductor layer — using — a conductor — a circuit may be formed.

[0068] Moreover, when a through hole is formed in the above (4) and the process of (5), it may be filled up with a resin filler in this through hole. Moreover, when filled up with a resin filler in a through hole, a wrap lid plating layer may be formed for the surface section of a resin filler layer by performing nonelectrolytic plating if needed.

[0069] (8) next, the thing for which roughening processing is performed on the front face of this lid plating layer, and the process of (3) - (7) is further repeated if needed when a lid plating layer is formed — the both sides — the resin insulating layer between layers, and a conductor — carry out laminating formation of the circuit. Moreover, a through hole may be formed and it is not necessary to form at this process.

[0070] (9) next, a conductor — form a solder resist layer in the outermost layer of the substrate in which the circuit and the resin insulating layer between layers were formed, if needed. The above-mentioned solder resist layer can be formed using the solder resist constituent which consists of for example, polyphenylene ether resin, polyolefin resin, a fluororesin, thermoplastic elastomer, an epoxy resin, polyimide resin, etc.

[0071] moreover, as solder resist constituents other than the above For example, the acrylate (meta) of a novolak mold epoxy resin, an imidazole curing agent, 2 functionality (meta) acrylic ester monomer, the polymer of with a molecular weight of about 500 to 5000 acrylic ester (meta), The fluid of the shape of a paste containing photosensitive monomers, such as thermosetting resin which consists of a bisphenol mold epoxy resin etc., and a multiple-valued acrylic monomer, a glycol ether system solvent, etc. is mentioned, and, as for the viscosity, it is desirable to be adjusted to 1 - 10 Pa-s at 25 degrees C. Moreover, the minimum of the thickness of the above-mentioned solder resist layer has desirable 10 micrometers, it is 15 micrometers more desirably, 30 micrometers of an upper limit are desirable, and it is 25 micrometers more desirably. In addition, as for the thickness of the above-mentioned solder resist layer, it is most desirable that it is 20 micrometers.

[0072] (10) Next, form opening for solder bump formation, and opening for optical element mounting in the above-mentioned solder resist layer. Formation of the above-mentioned opening for solder bump formation and opening for optical element mounting can be performed using the approach of forming opening for the Bahia halls, and the same approach, i.e., an exposure development and the lasing. Moreover, in case a solder resist layer is formed, the solder resist layer which has opening for solder bump formation and opening for optical element mounting may be formed by producing the resin film which has opening in a desired location, and sticking this resin film on it beforehand. moreover, as a diameter of opening of the above-mentioned opening for optical element mounting The pitch of the solder pad (connection terminal) of a photo detector and a light emitting device That what is necessary is just to adjust suitably according to (for example, 100-250 micrometers) and the diameter (for example, 50-200 micrometers) of the above-mentioned solder pad specifically for example, the diameter of the above-mentioned solder pad and abbreviation — it may be the same

and may be larger than the diameter of the above-mentioned solder pad about 10-30 micrometers. When it is made larger than the diameter of a solder pad, the bonding strength of solder can be raised.

[0073] (11) next, the conductor exposed by forming the above-mentioned opening for solder bump formation — if needed, a circuit part is covered with corrosion-resistant metals, such as nickel, palladium, gold, silver, and platinum, and let it be a solder pad. In these, it is desirable to form an enveloping layer with metals, such as nickel-gold, nickel-silver, nickel-palladium, and nickel-palladium-gold. Although the above-mentioned enveloping layer can be formed according to plating, vacuum evaporationo, electrodeposition, etc., in these, it is desirable to form with plating from the point of excelling in the homogeneity of an enveloping layer. moreover, the conductor exposed by forming opening for optical element mounting at this process — it is desirable to form an enveloping layer also in a circuit part.

[0074] (12) Next, form a solder bump by carrying out a reflow after filling up the above-mentioned solder pad with soldering paste through the mask with which opening was formed in the part equivalent to the above-mentioned solder pad. As a presentation of the above-mentioned soldering paste, Sn:Ag(weight ratio) =96.5:3.5 (the melting point of 221 degrees C, eutectic) is mentioned. Moreover, as a presentation of others of the above-mentioned soldering paste, the SnAgCu system of Sn:Ag:Cu(weight ratio) =96.5:3.0:0.5 grade, the SnCu system of Sn:Cu(weight ratio) =99.3:0.7 grade, the SnSb system of Sn:Sb(weight ratio) =95.0:5.0 grade, etc. are mentioned, for example.

[0075] (13) An optical element (a photo detector and light emitting device) is further mounted in a solder resist layer. What is necessary is for mounting of an optical element to fill up soldering paste with the process of the above (12) also into opening for optical element mounting, and just to mount it through solder (conductive layer) further, by carrying out alignment and attaching the above-mentioned optical element, in case a reflow is performed. Moreover, it may replace with solder and an optical element may be mounted using electroconductive glue etc. When these approaches are used, a photo detector and a light emitting device will be mounted in the front face of a solder resist layer. By passing through such a process, the substrate for IC chip mounting of the first this invention can be manufactured.

[0076] Next, the substrate for IC chip mounting of the second this invention is explained. the substrate for IC chip mounting of the second this invention — both sides of a substrate — a conductor — a circuit and the resin insulating layer between layers are the substrates for IC chip mounting by which laminating formation was carried out, and it is characterized by building in or containing the photo detector and the light emitting device at the field side of 1 of the above-mentioned substrate for IC chip mounting so that a light sensing portion and a light-emitting part may be exposed, respectively.

[0077] With the substrate for IC chip mounting of the second this invention, since the photo detector and the light emitting device are mounted on the surface of the substrate, when IC chip is mounted in this substrate, the distance of IC chip and an optic is short and it excels in the dependability of electrical signal transmission. Moreover, in the substrate for IC chip mounting of this invention which mounted IC chip, since electronic parts and an optic required for optical communication can be unified, it can contribute to the miniaturization of the terminal equipment for optical communication.

[0078] Moreover, the solder resist layer is formed in the outermost layer of the side in which the above-mentioned photo detector etc. is mounted also in the substrate for IC chip mounting of the second this invention. When the solder bump is formed in this solder resist layer The above-mentioned substrate for IC chip mounting is connectable with an external substrate through a solder bump, and in this case, since the above-mentioned substrate for IC chip mounting can be arranged to a position according to the self-alignment operation which solder has, an exact lightwave signal can be transmitted.

[0079] Compared with the substrate for IC chip mounting of the first this invention, as for the substrate for IC chip mounting of the second this invention, the mounting approaches of a photo detector and a light emitting device differ. That is, with the substrate for IC chip mounting of the first this invention, to the photo detector and the light emitting device being mounted in the front face of 1 of this substrate for IC chip mounting, with the substrate for IC chip mounting of the second this invention, the photo detector and the light emitting device are built in or contained so that a light sensing portion and a light-emitting part may be exposed to the front-face side of 1 of this substrate for IC chip mounting, respectively (both are only hereafter called receipt collectively).

[0080] Hereafter, the operation gestalt of the substrate for IC chip mounting of the second this invention is explained, referring to a drawing. Drawing 2 is the sectional view showing typically 1 operation gestalt of the substrate for IC chip mounting of the second this invention. In addition, drawing 2 shows the substrate for IC chip mounting in the condition that IC chip was mounted.

[0081] it is shown in drawing 2 — as — the mounting substrate 220 for IC chip — both sides of a substrate 221 — a conductor — the conductor with which laminating formation was carried out and the substrate 221 of the resin insulating layer [a circuit 224 and] 222 between layers was pinched — the conductor which sandwiched

the resin insulating layer 222 between layers between circuits — the through hole 229 and the Bahia hall 227 connect electrically between circuits, respectively. moreover, a photo detector 238 and a light emitting device 239 contain in the solder resist layer 234 so that light sensing portion 238a and light-emitting part 239a may be exposed to the field side of 1 of the mounting substrate 220 for IC chip, respectively — having — a photo detector 238 and a light emitting device 239 — a conductor layer 242 — minding — a conductor — it connects with the circuit 224. Moreover, the solder bump 237 is formed in the near solder resist layer 234 by which the photo detector 238 grade is contained, and the IC chip 240 is mounted in other front faces of the substrate 220 for IC chip mounting through the solder connection 243.

[0082] In the substrate for IC chip mounting of the second this invention, in the photo detector and light emitting device which were mounted in the location near IC chip, since light / electrical signal conversion is performed, the transmission distance of an electrical signal is short, is excellent in the dependability of a signal transmission, and can respond to a high-speed communication link more.

[0083] Moreover, in the substrate 220 for IC chip mounting, since the solder bump 237 is formed in the solder resist layer by the side of the field of 1, the electrical signal sent out from IC chip can be sent out to an external substrate through this solder bump 237. Moreover, power required for making IC chip drive from the exterior of the substrate 220 for IC chip mounting can also be supplied through the solder bump 237.

[0084] As the photo detector mounted in the substrate for IC chip mounting of such second this invention, or a light emitting device, the same thing as the photo detector and light emitting device which are mounted in the substrate for IC chip mounting of the first this invention etc. is mentioned, for example.

[0085] Next, how to manufacture the substrate for IC chip mounting of the second this invention is explained. (1) the first same approach as the process of manufacture approach [of the substrate for IC chip mounting of the first this invention] (1) - (8) — using — the both sides — a conductor — while laminating formation of a circuit and the resin insulating layer between layers is carried out, manufacture the substrate with which the Bahia hall and the through hole were formed.

[0086] (2) next, a conductor — form a solder resist layer in the outermost layer of the substrate in which the circuit and the resin insulating layer between layers were formed, if needed. The above-mentioned solder resist layer can be formed using the same approach as the process of the manufacture approach (9) of the substrate for IC chip mounting of the first this invention. In addition, when the exposure of the above-mentioned solder resist layer forms the same field as the light-receiving side of a photo detector, or the luminescence side of a light emitting device, for example, the thickness of the above-mentioned photo detector and the above-mentioned light emitting device is 300 micrometers and these solder connection height is 50 micrometers, the thickness of the above-mentioned solder resist layer is 350 micrometers. However, depending on the case, the thickness of the above-mentioned solder resist layer does not need to be 350 micrometers strictly, for example, may be 300-400 micrometers.

[0087] (3) Next, form opening for solder bump formation, and opening for optical element receipt in the above-mentioned solder resist layer. Formation of the above-mentioned opening for solder bump formation can be performed using the same approach as the process of the manufacture approach (10) of the substrate for IC chip mounting of the first this invention, i.e., the approach of forming opening for the Bahia halls, and the same approach. Moreover, formation of the above-mentioned opening for optical element receipt can be performed using the same approach as formation of the above-mentioned opening for solder bump formation. Moreover, in case a solder resist layer is formed, the solder resist layer which has opening for solder bump formation and opening for optical element receipt may be formed by producing the resin film which has opening in a desired location, and sticking this resin film on it beforehand.

[0088] (4) next, the conductor exposed by forming the above-mentioned opening for solder bump formation — a circuit part is covered if needed and let it be a solder pad. the conductor which specifically exposed the first this invention at this process again by [which form an enveloping layer using the same approach as the process of the manufacture approach (11) of the substrate for IC chip mounting] forming opening for optical element receipt — it is desirable to form an enveloping layer also in a circuit part.

[0089] (5) Next, form a solder bump by carrying out a reflow after filling up the above-mentioned solder pad with soldering paste through the mask with which opening was formed in the part equivalent to the above-mentioned solder pad.

[0090] (6) Further, it contains so that a light sensing portion and a light-emitting part may expose a photo detector and a light emitting device to a solder resist layer, respectively. What is necessary is for mounting of an optical element (a photo detector and light emitting device) to fill up soldering paste with the process of the above (5) also into opening for optical element receipt, and just to mount it through solder (conductive layer) further, by attaching the above-mentioned optical element, in case a reflow is performed. Moreover, it may replace with solder and an optical element may be mounted using electroconductive glue etc.

[0091] Moreover, although the optical element is contained by the approach of performing the process of above-mentioned (2) - (5) after forming a solder resist layer, it may replace with such an approach and receipt of an optical element and a solder bump's formation may be performed using the following approaches. that is, pass the process of the above (1) — the both sides — a conductor — while laminating formation of a circuit and the resin insulating layer between layers is carried out, after manufacturing the substrate with which the Bahia hall and the through hole were formed — first — soldering paste and electroconductive glue — minding — an optical element — a conductor — it attaches in a circuit. Next, the solder resist layer by which the optical element was contained is formed by applying a solder resist constituent to optical element the non-mounting section, or sticking by pressure the solder resist constituent fabricated in the shape of [which has opening into the part equivalent to the part which contains an optical element] a film.

[0092] Furthermore, a solder bump is formed like the process of above-mentioned (3) - (5) by performing formation of an enveloping layer, and restoration of soldering paste formation of opening for solder bump formation, and if needed.

[0093] When these approaches are used, a photo detector and a light emitting device will be built in or contained at the field side of 1 of the substrate for IC chip mounting. By passing through such a process, the substrate for IC chip mounting of the second this invention can be manufactured.

[0094] Next, the substrate for IC chip mounting of the third this invention is explained. the substrate of the third this invention for IC chip mounting — both sides of a substrate — a conductor — a circuit and the resin insulating layer between layers are the substrates for IC chip mounting by which laminating formation was carried out, and while a photo detector and a light emitting device are laid underground, it is characterized by to be secured the optical path which connects the light sensing portion and the lightwave signal of the above-mentioned photo detector, and the optical path which connects the light-emitting part and the lightwave signal of the above-mentioned light emitting device at the field side of 1 of the above-mentioned substrate for IC chip mounting.

[0095] With the substrate for IC chip mounting of the third this invention, since the photo detector and the light emitting device are mounted on the surface of the substrate, when IC chip is mounted in this substrate, the distance of IC chip and an optic is short and it excels in the dependability of electrical signal transmission. Moreover, in the substrate for IC chip mounting of this invention which mounted IC chip, since electronic parts and an optic required for optical communication can be unified, it can contribute to the miniaturization of the terminal equipment for optical communication.

[0096] Moreover, a solder resist layer is formed in the outermost layer of the side in which the above-mentioned photo detector etc. is mounted also in the substrate for IC chip mounting of the third this invention. When the solder bump is formed in this solder resist layer The above-mentioned substrate for IC chip mounting is connectable with an external substrate through a solder bump, and in this case, since the above-mentioned substrate for IC chip mounting can be arranged to a position according to the self-alignment operation which solder has, an exact lightwave signal can be transmitted.

[0097] Compared with the substrate for IC chip mounting of the first this invention, as for the substrate for IC chip mounting of the third this invention, the mounting approaches of a photo detector and a light emitting device differ. That is, in the substrate for IC chip mounting of the first this invention, while a photo detector and a light emitting device are laid underground with the substrate for IC chip mounting of the third this invention at the field side of 1 of this substrate for IC chip mounting to the photo detector and the light emitting device being mounted in the front face of 1 of this substrate for IC chip mounting, the optical path which connects the light sensing portion of the above-mentioned photo detector, the light-emitting part of a light emitting device, and a lightwave signal is secured.

[0098] Hereafter, the operation gestalt of the substrate for IC chip mounting of the third this invention is explained, referring to a drawing. Drawing 3 is the sectional view showing typically 1 operation gestalt of the substrate for IC chip mounting of the third this invention. In addition, drawing 3 shows the substrate for IC chip mounting in the condition that IC chip was mounted.

[0099] it is shown in drawing 3 — as — the mounting substrate 320 for IC chip — both sides of a substrate 321 — a conductor — the conductor with which laminating formation was carried out and the substrate 321 of the resin insulating layer [a circuit 324 and] 322 between layers was pinched — the conductor which sandwiched the resin insulating layer 322 between layers between circuits — the through hole 329 and the Bahia hall 327 connect electrically between circuits, respectively. moreover, a photo detector 338 and a light emitting device 339 lay under the field side of 1 of the mounting substrate 320 for IC chip, respectively — having — a conductor — while connecting through a circuit 324 and a conductor layer 342, the opening 340 for optical paths which connects a lightwave signal with light sensing portion 338a or light-emitting part 339a is secured.

[0100] In the substrate for IC chip mounting of the third this invention, in the photo detector and light emitting

device which were mounted in the location near IC chip, since light / electrical signal conversion is performed, the transmission distance of an electrical signal is short, is excellent in the dependability of a signal transmission, and can respond to a high-speed communication link more.

[0101] Moreover, in the substrate 320 for IC chip mounting, since the solder bump 337 is formed in the solder resist layer by the side of the field of 1, the electrical signal sent out from IC chip can be sent out to an external substrate through this solder bump 337. Moreover, power required for making IC chip drive from the exterior of the substrate 320 for IC chip mounting can also be supplied through the solder bump 337.

[0102] Moreover, although a role of an optical path for opening for optical element laying under the ground prepared in order to lay a photo detector 338 and a light emitting device 339 underground to turn into the opening 340 (340a, 340b) for optical paths as it is, and connect a lightwave signal with a photo detector 338 or a light emitting device 339 will be played in the substrate 320 for IC chip mounting, the above-mentioned opening for optical paths may be prepared only in the part which counters the light sensing portion and light-emitting part of a photo detector and a light emitting device. Moreover, in the substrate 320 for IC chip mounting, although the photo detector 338 and the light emitting device 339 are laid under the solder resist layer, the laying-under-the-ground location of optical elements, such as a photo detector, is not limited to a solder resist layer, but as long as the optical path is secured, it may be laid under the resin insulating layer between layers, or the substrate, and it may be laid underground so that two or more layers may be straddled.

[0103] Moreover, you may fill up with the above-mentioned optical path with resin etc. In this case, dust adheres to a light sensing portion or a light-emitting part, or there is no possibility that it may be sufficient for a blemish just and it may carry out, and the high connection dependability of a lightwave signal can be secured more certainly. Moreover, as an ingredient with which the above-mentioned optical path is filled up, especially if there is little absorption by the communication link wavelength range, it will not be limited, for example, it is epoxy resin;UV hardenability epoxy resin; polyolefine system resin ;P Silicone resin, such as polyimide resin; deuteration silicone resin, such as acrylic resin; fluorination polyimide, such as MMA (polymethylmethacrylate), Deuteration PMMA, and heavy hydrogen fluorination PMMA; the polymer manufactured from benz-cyclo-butene is mentioned.

[0104] As the photo detector mounted in the substrate for IC chip mounting of such third this invention, or a light emitting device, the same thing as the photo detector and light emitting device which are mounted in the substrate for IC chip mounting of the first this invention etc. is mentioned, for example.

[0105] Next, how to manufacture the substrate for IC chip mounting of the third this invention is explained.

(1) the first same approach as the process of manufacture approach [of the substrate for IC chip mounting of the first this invention] (1) - (8) — using — the both sides — a conductor — while laminating formation of a circuit and the resin insulating layer between layers is carried out, manufacture the substrate with which the Bahia hall and the through hole were formed.

[0106] (2) next, a conductor — form a solder resist layer in the outermost layer of the substrate in which the circuit and the resin insulating layer between layers were formed, if needed. The above-mentioned solder resist layer can be formed using the same approach as the process of the manufacture approach (9) of the substrate for IC chip mounting of the first this invention. When a photo detector and a light emitting device are flip chip die parts, the thickness of the above-mentioned solder resist layer Moreover, the thickness of the above-mentioned photo detector and the above-mentioned light emitting device, When the above-mentioned photo detector and the above-mentioned light emitting device are wire-bonding die parts, that what is necessary is just more thickly than the thickness which combined these solder connection height The thickness of the above-mentioned photo detector and the above-mentioned light emitting device, What is necessary is just to make it thicker about 100 micrometers than the case of the above-mentioned flip chip die parts that what is necessary is just more thickly than the thickness which combined these solder connection height and the height of a wire part.

[0107] (3) Next, form opening for solder bump formation, and opening for optical element laying under the ground in the above-mentioned solder resist layer. Formation of the above-mentioned opening for solder bump formation can be performed using the same approach as the process of the manufacture approach (10) of the substrate for IC chip mounting of the first this invention, i.e., the approach of forming opening for the Bahia halls, and the same approach. Moreover, formation of the above-mentioned opening for optical element laying under the ground can be performed using the same approach as formation of the above-mentioned opening for solder bump formation. Moreover, in case a solder resist layer is formed, the solder resist layer which has opening for solder bump formation and opening for optical element laying under the ground may be formed by producing the resin film which has opening in a desired location, and sticking this resin film on it beforehand.

[0108] (4) next, the conductor exposed by forming the above-mentioned opening for solder bump formation — a circuit part is covered if needed and let it be a solder pad. the conductor exposed at this process again by [which specifically form an enveloping layer using the same approach as the process of the manufacture

approach (11) of the substrate for IC chip mounting of the first this invention] forming opening for optical element laying under the ground — it is desirable to form an enveloping layer also in a circuit part.
[0109] (5) Next, form a solder bump by carrying out a reflow after filling up the above-mentioned solder pad with soldering paste through the mask with which opening was formed in the part equivalent to the above-mentioned solder pad.
[0110] (6) A photo detector and a light emitting device are further laid under the solder resist layer at opening for optical element laying under the ground, respectively. What is necessary is to fill up soldering paste with the process of the above (5) also into opening for optical element laying under the ground, and just to specifically mount through solder (conductive layer) further, by attaching the above-mentioned optical element, in case a reflow is performed. Moreover, it may replace with solder and an optical element may be mounted using electroconductive glue etc. In addition, when the above-mentioned photo detector and the above-mentioned light emitting device are wire-bonding die parts, a wire part is closed by resin, and when especially the above-mentioned wire parts are a light-receiving side and a luminescence side, it closes with the resin filled up with the optical path mentioned above.
[0111] Moreover, although the optical element is laid underground by the approach of performing the process of above-mentioned (2) – (5) after forming a solder resist layer, it may replace with such an approach and laying under the ground of an optical element and a solder bump's formation may be performed using the following approaches. When forming an optical path only in the part which counters the light sensing portion which an optical element has especially, and a light-emitting part, it is desirable to use the following approach.
[0112] that is, pass the process of the above (1) — the both sides — a conductor — while laminating formation of a circuit and the resin insulating layer between layers is carried out, after manufacturing the substrate with which the Bahia hall and the through hole were formed — first — soldering paste and electroconductive glue — minding — an optical element — a conductor — it attaches in a circuit. Next, a solder resist layer is formed by applying a solder resist constituent to optical element the non-mounting section, or sticking by pressure the solder resist constituent fabricated in the shape of [which has opening into the part equivalent to an optical element] a film.
[0113] Furthermore, laying under the ground of an optical element and a solder bump's formation are performed like the process of above-mentioned (3) – (5) by performing formation of an enveloping layer, and restoration of soldering paste formation of opening for solder bump formation, and opening for optical paths, and if needed. In addition, when laying an optical element underground using this approach, it is desirable to use a photopolymer constituent for a solder resist constituent, and to form opening for optical paths by exposure and the development. When opening for optical paths is formed by the lasing, it is because there are a front face of an optical element and a possibility of attaching a blemish to a light sensing portion or a light-emitting part especially. Moreover, what is necessary is just to form an optical path, after mounting the optical element and carrying out laminating formation of the solder resist layer, in case this resin insulating layer between layers is formed in laying an optical element under the resin insulating layer between layers except a solder resist layer.
[0114] When these approaches are used, a photo detector and a light emitting device will be laid under the field side of 1 of the substrate for IC chip mounting. By passing through such a process, the substrate for IC chip mounting of the third this invention can be manufactured.
[0115]
[Example] Hereafter, this invention is further explained to a detail.
(Example 1)
A. The production bisphenol A mold epoxy resin (weight-per-epoxy-equivalent 469, Epicoat 1001 by oil-ized shell epoxy company) 30 weight section of the resin film for the resin insulating layers between layers, The cresol novolak mold epoxy resin (weight-per-epoxy-equivalent 215, Epiclon N-673 by Dainippon Ink & Chemicals, Inc.) 40 weight section, The triazine structure content phenol novolak resin (phenol nature hydroxyl equivalent 120, Dainippon Ink & Chemicals, Inc. make FENO light KA-7052) 30 weight section The ethyl diethylene glycol acetate 20 weight section, The heating dissolution is carried out stirring in the solvent naphtha 20 weight section. There The end epoxidation polybutadiene rubber (Nagase Brothers formation DENAREKKUSU R-45 by industrial company EPT) 15 weight section, and the 2-phenyl -4, the 5-screw (hydroxymethyl) imidazole grinding article 1.5 weight section, The pulverizing silica 2 weight section and the silicon system defoaming agent 0.5 weight section were added, and the epoxy resin constituent was prepared. After applying using a roll coater so that the thickness after drying the obtained epoxy resin constituent on a PET film with a thickness of 38 micrometers may be set to 50 micrometers, the resin film for the resin insulating layers between layers was produced by making it dry for 10 minutes at 80-120 degrees C.
[0116] The mean particle diameter by which coating of the silane coupling agent was carried out to the preparation bisphenol female mold epoxy monomer (oil-ized shell company make, molecular weight : 310 YL983U)

100 weight section of the resin constituent for through tube restoration and a front face B. By 1.6 micrometers the diameter of grain of maximum size — SiO2 spherical particle (the Adtec Corp. make —) 15 micrometers or less CRS The viscosity prepared the resin filler of 45 - 49 Pa-s at 23**1 degree C by carrying out stirring mixing of the 1101-CE170 weight section and the leveling agent (Sannopuko PERENORU S4) 1.5 weight section for a container. In addition, the imidazole curing agent (Shikoku formation shrine make, 2E4 MZ-CN) 6.5 weight section was used as a curing agent.

[0117] C. Copper clad laminate which 18-micrometer copper foil 28 laminates to both sides of the insulating substrate 21 which consists of the glass epoxy resin with a manufacture (1) thickness of 0.8mm or BT (bismaleimide triazine) resin of the substrate for IC chip mounting was used as the start ingredient (refer to drawing 4 (a)). first, the thing which drill drilling of this copper clad laminate is carried out, and nonelectrolytic plating processing is performed, and is etched in the shape of a pattern — both sides of a substrate 21 — a conductor — the circuit 24 and the through hole 29 were formed.

[0118] (2) Wash in cold water the substrate in which the circuit 24 was formed. a through hole 29 and a conductor — NaOH (10 g/l) after drying, and NaClO2 (40 g/l), Melanism processing the water solution containing Na3 PO4 (6 g/l) — melanism — it considers as a bath (oxidation bath) — and the conductor which performs reduction processing which makes a reduction bath NaOH (10 g/l) and the water solution containing NaBH4 (6 g/l), and includes a through hole 29 — the roughening side (not shown) was formed in the front face of a circuit 24 (refer to drawing 4 (b)).

[0119] (3) the following approach after preparing the resin filler indicated to Above B — after preparation — less than 24 hours — the conductor of one side of the inside of a through hole 29, and a substrate 21 — the circuit agenesis section and a conductor — the layer of resin filler 30' was formed in the rim section of a circuit 24. That is, after pushing in a resin filler in a through hole using a squeegee, it was made to dry on 100 degrees C and the conditions for 20 minutes first. next, a conductor — the conductor with which the part equivalent to the circuit agenesis section lays on a substrate the mask which carried out opening, and serves as a crevice using the squeegee — the circuit agenesis section was also filled up with the resin filler, and the layer of resin filler 30' was formed by making it dry on 100 degrees C and the conditions for 20 minutes (refer to drawing 4 (c)).

[0120] (4) the belt sander [one side / which finished processing of the above (3) / of a substrate] polish using the belt abrasive paper (Sankyo Rikagaku make) of **600 — a conductor — it ground so that resin filler 30' might remain neither in the front face of a circuit 24, nor the land front face of a through hole 29, and subsequently buffing for removing the blemish by the above-mentioned belt sander polish was performed. Such a series of processings were similarly performed about the field of another side of a substrate. Subsequently, by 100 degrees C, it performed at 150 degrees C for 1 hour for 3 hours, 120 degrees C performed heat-treatment of 7 hours at 180 degrees C for 1 hour, and the resin filler layer 30 was formed.

[0121] thus, a through hole 29 and a conductor — the surface section of the resin filler 30 formed in the circuit agenesis section, and a conductor — the front face of a circuit 24 — flattening — carrying out — the resin filler 30 and a conductor — the insulating substrate which the side face of a circuit 24 stuck firmly through the roughening side (not shown), and the internal surface and the resin filler 30 of a through hole 29 stuck firmly through the roughening side (not shown) was obtained (refer to drawing 4 (d)). this process — the front face of the resin filler layer 30, and a conductor — the front face of a circuit 24 turns into the same flat surface.

[0122] (5) software etching after rinsing and carrying out acid cleaning of the above-mentioned substrate — carrying out — subsequently — an etching reagent — both sides of a substrate — a spray — spraying — a conductor — etching the front face of a circuit 24, the land front face of a through hole 29, and a wall — a conductor — all the front faces of a circuit 24 — a roughening side (not shown). As an etching reagent, the etching reagent (the product made from MEKKU, MEKKU dirty bond) containing the imidazole copper (II) complex 10 weight section, the glycolic-acid 7 weight section, and the potassium chloride 5 weight section was used.

[0123] (6) Next, the somewhat larger resin film for the resin insulating layers between layers than the substrate produced by Above A was laid on the substrate, and after carrying out temporary sticking by pressure and judging on pressure 0.4MPa, the temperature of 80 degrees C, and the conditions for sticking-by-pressure time amount 10 seconds, the resin insulating layer 22 between layers was formed by sticking using vacuum laminator equipment by the approach of further the following (refer to drawing 4 (e)). That is, on the substrate, actual sticking by pressure was carried out on the degree of vacuum of 65Pa, pressure 0.4MPa, temperature 80, and the conditions for time amount 60 seconds, and heat curing of the resin film for the resin insulating layers between layers was carried out for 30 minutes at 170 degrees C after that.

[0124] (7) Next, mind the mask with which the through tube with a thickness of 1.2mm was formed on the resin insulating layer 22 between layers, and it is CO2 with a wavelength of 10.4 micrometers. By gas laser, the opening 26 for the Bahia halls with a diameter of 80 micrometers was formed in the resin insulating layer 22 between layers on the beam diameter of 4.0mm, the Top Hat mode, 8.0 microseconds of pulse width, the path of

1.0mm of the through tube of a mask, and the conditions of one shot (refer to drawing 5 (a)).
[0125] (8) The roughening side (not shown) was formed in the front face containing the internal surface of the opening 26 for the Bahia halls by immersing the substrate in which the opening 26 for the Bahia halls was formed, for 10 minutes in the 80-degree C solution containing the permanganic acid of 60 g/l, and carrying out dissolution removal of the epoxy resin particle which exists in the front face of the resin insulating layer 22 between layers.
[0126] (9) Next, the substrate which finished the above-mentioned processing was washed in cold water after being immersed in the neutralization solution (product made from SHIPUREI). Furthermore, the catalyst nucleus was made for the front face of this substrate that carried out the surface roughening process (a roughening depth of 3 micrometers) to adhere to the front face (for the internal surface of the opening 26 for the Bahia halls to be included) of the resin insulating layer 22 between lower layer layers by giving a palladium catalyst (not shown). That is, the above-mentioned substrate was immersed into the catalytic liquid containing a palladium chloride (PdCl2) and a stannous chloride (SnCl2), and the catalyst was given by depositing a palladium metal.
[0127] (10) Next, into the non-electrolytic copper plating water solution of the following presentations, the substrate was immersed and the thin film conductor layer (non-electrolytic copper plating film) 32 with a thickness of 0.6-3.0 micrometers was formed at the front face (the internal surface of the opening 26 for the Bahia halls is included) of the resin insulating layer 22 between layers, and the wall surface of a through tube 29 (refer to drawing 5 (b)).
[Nonelectrolytic plating water solution]
NiSO4 0.003 mol/l tartaric acid 0.200 mol/l copper sulfate 0.030 mol/lHCHO 0.050 mol/lNaOH 0.100 mol/lalpha and alpha'-bipyridyl 100 mg/l polyethylene glycol (PEG) 0.10 g/l [nonelectrolytic plating conditions]
It is 40 minutes [0128] by whenever [30-degree C solution temperature]. (11) Next, stick a commercial photosensitive dry film on the substrate with which the thin film conductor layer (non-electrolytic copper plating film) 32 was formed, lay a mask, and it is 100 mJ/cm2. The plating resist 23 with a thickness of 20 micrometers was formed by exposing and carrying out a development in a sodium-carbonate water solution 0.8% (refer to drawing 5 (c)).
[0129] (12) Subsequently, 50-degree C water washed the substrate and it degreased, with 25-degree C water, after washing with the sulfuric acid further after rinsing, electrolysis plating was performed on condition that the following, and the electrolytic copper plating film 33 with a thickness of 20 micrometers was formed in the plating-resist 23 agenesis section (refer to drawing 5 (d)).
[Electrolysis plating liquid]
Sulfuric acid 2.24 mol/l copper sulfate 0.26 mol/l additive 19.5 ml/l (made in ATOTEKKU Japan, KAPARASHIDO HL)
[Electrolysis plating conditions]
Current density 1 A/dm 2 hours 65 Part temperature 22**2 ** [0130] (13) — a conductor with a thickness of 18 micrometers which carries out etching processing of the thin film conductor layer under the plating resist 23 with the mixed liquor of a sulfuric acid and a hydrogen peroxide, carries out dissolution removal and consists of a thin film conductor layer (non-electrolytic copper plating film) 32 and electrolytic copper plating film 33 further after carrying out exfoliation removal of the plating resist 23 by NaOH 5% — the circuit 25 (the Bahia hall 27 is included) was formed (refer to drawing 6 (a)).
[0131] (14) next, the thing for which the process of the process of above-mentioned (5) - (13) is repeated — the upper resin insulating layer between layers, and a conductor — laminating formation of the circuit was carried out (refer to drawing 6 (b) - drawing 6 (c)). furthermore, the approach used at the process of the above (5) and the same approach — using — the conductor of the outermost layer — the roughening side was formed in the circuit.
[0132] (15) Next, made it dissolve so that it may become 60% of the weight of concentration to diethylene-glycol wood ether (DMDG). The oligomer (molecular weight: 4000) 46.67 weight section of the photosensitive grant which acrylic-ized 50% of epoxy groups of a cresol novolak mold epoxy resin (Nippon Kayaku Co., Ltd. make), 80% of the weight of the bisphenol A mold epoxy resin (oil-ized shell company make —) dissolved in the methyl ethyl ketone trade name: — the Epicoat 1001 15.0 weight section and an imidazole curing agent (Shikoku — formation — shrine make —) trade name: — 2 organic-functions acrylic monomer (the Nippon Kayaku Co., Ltd. make —) which are the 2E4 MZ-CN1.6 weight section and a photosensitive monomer trade name: — the R604 4.5 weight section — the same — a multiple-valued acrylic monomer (the Kyoei Kagaku K.K. make —) trade name: — the DPE6A1.5 weight section and a dispersed system defoaming agent (the Sannopuko make —) Stir the S-65 0.71 weight section for a container, mix, and a mixed constituent is prepared. The solder resist constituent which adjusted viscosity to 2.0 Pa-s at 25 degrees C was obtained by adding the benzophenone (Kanto chemistry company make) 2.0 weight section and the Michler's-ketone (Kanto chemistry company make) 0.2 weight section

as a photosensitizer as a photopolymerization initiator to this mixed constituent. In addition, in the case of 60min-1 (rpm), in the case of rotor No.4 and 6min-1 (rpm), measurement of viscosity was based on rotor No.3 by the Brookfield viscometer (the Tokyo Keiki Co., Ltd. make, DVL-B mold).

[0133] (16) next, the resin insulating layer 22 between layers and a conductor — the above-mentioned solder resist constituent was applied by the thickness of 30 micrometers, for 20 minutes was performed at 70 degrees C, desiccation processing was performed to both sides of the substrate in which the circuit 25 (the Bahia hall 27 is included) was formed, the condition for 30 minutes at 70 degrees C, and the layer of a solder REJISU constituent was formed in them.

[0134] (17) Subsequently, stick the photo mask with a thickness of 5mm with which the pattern of opening for solder bump formation was drawn in the layer of the solder resist constituent by the side of IC chip mounting, and they are 1000 mJ/cm2. It exposed by ultraviolet rays, the development was carried out with the DMTG solution, and opening with a diameter of 200 micrometers was formed. Moreover, the photo mask with a thickness of 5mm with which the pattern of opening for solder bump formation and opening for optical element mounting was drawn was stuck in the layer of the solder resist constituent by the side of optical element mounting, and opening with a diameter of 200 micrometers and opening with a diameter of 180 micrometers were formed in it by performing exposure and a development on the above-mentioned conditions. Furthermore, carry out at 120 degrees C for 1 hour for 1 hour, heat-treat [80 degrees C / 100 degrees C] on the conditions of 3 hours by 150 degrees C for 1 hour, respectively, and the layer of a solder resist constituent is stiffened. It has the opening 35 for solder bump formation, and has the solder resist layer the thickness of whose is 20 micrometers, and the opening 35 for solder bump formation and the opening 31 for optical element mounting, and the solder resist layer 34 the thickness of whose is 20 micrometers was formed (refer to drawing 7 (a)). In addition, a commercial solder resist constituent can also be used as the above-mentioned solder resist constituent.

[0135] (18) Next, the substrate in which the solder resist layer 34 was formed was immersed in the non-electrolyzed nickel-plating liquid of pH=4.5 containing a nickel chloride (2.3x10-1 mol/l), sodium hypophosphite (2.8x10-1 mol/l), and a sodium citrate (1.6x10-1 mol/l) for 20 minutes, and the nickel-plating layer with a thickness of 5 micrometers was formed in the opening 35 for solder bump formation, and the opening 31 for optical element mounting. Furthermore, the substrate was immersed in the non-electrolyzed gilding liquid containing a gold cyanide potassium (7.6x10-3 mol/l), an ammonium chloride (1.9x10 to 1 mol/l.), a sodium citrate (1.2x10-1 mol/l), and sodium hypophosphite (1.7x10-1 mol/l) for 7.5 minutes on 80-degree C conditions, the gilding layer with a thickness of 0.03 micrometers was formed on the nickel-plating layer, and it considered as the solder pad 36.

[0136] (19) Next, print soldering paste to the opening 35 for solder bump formation and the opening 31 for optical element mounting which were formed in the solder resist layer 34. Furthermore, by attaching in the soldering paste printed to the opening 31 for optical element mounting, performing alignment of light sensing portion 38a of a photo detector 38 and a light emitting device 39, and light-emitting part 39a, and carrying out a reflow to it at 200 degrees C While mounting the photo detector 38 and the light emitting device 39, the solder bump 37 was formed in the opening 35 for solder bump formation, and it considered as the substrate for IC chip mounting. In addition, as a photo detector 38, what consists of InGaAsP was used as a light emitting device 39 using what consists of InGaAs (refer to drawing 7 (b)). By passing through such a process, by this example, the substrate for IC chip mounting with which the photo detector and the light emitting device were mounted was manufactured so that a light sensing portion and a light-emitting part might be exposed to the front face of 1, respectively.

[0137] (Example 2)

(1) the first same approach as the process of (1) - (14) of an example 1 — using — the both sides — the resin insulating layer between layers, and a conductor — the circuit manufactured the substrate by which laminating formation was carried out.

(2) Next, the layer of a solder resist constituent was formed using the same approach as the process of (15) of an example 1, and (16).

[0138] (3) The photo mask with a thickness of 5mm with which the pattern of opening for solder bump formation was drawn is further stuck in the layer of the solder resist constituent by the side of IC chip mounting, and they are 1000 mJ/cm2. It exposed by ultraviolet rays, the development was carried out with the DMTG solution, and opening with a diameter of 200 micrometers was formed. Moreover, the photo mask with a thickness of 5mm with which the pattern of opening for solder bump formation and opening for optical element receipt was drawn was stuck in the layer of the solder resist constituent by the side of optical element mounting, and opening for solder bump formation (diameter of 200 micrometers) and opening for optical element receipt were formed in it by performing exposure and a development on the above-mentioned conditions. Furthermore, the layer of a

solder resist constituent is stiffened on the same conditions as (17) of an example 1, and it has opening for solder bump formation, and has the solder resist layer the thickness of whose is 20 micrometers, and opening for solder bump formation and opening for optical element receipt, and the solder resist layer 34 the thickness of whose is 20 micrometers was formed.

[0139] (4) Next, the enveloping layer (solder pad) was formed in opening for solder bump formation, and opening for optical element receipt using the same approach as the process of (18) of an example 1.

(5) Next, although a solder bump is formed in opening for solder bump formation formed in the solder resist layer, while printing the soldering paste of a complement, soldering paste was printed also to opening for optical element receipt. Furthermore, by containing a photo detector and a light emitting device to this opening for optical element receipt, and carrying out a reflow at 200 degrees C, while mounting the photo detector and the light emitting device, the solder bump was formed, and it considered as the substrate for IC chip mounting. In addition, as a photo detector and a light emitting device, the same thing as an example 1 was used. By passing through such a process, by this example, the substrate for IC chip mounting (refer to drawing 2) with which the photo detector and the light emitting device were contained was manufactured so that a light sensing portion and a light-emitting part might be exposed to the field side of 1, respectively.

[0140] (Example 3) (1) — the first same approach as the process of (1) – (14) of an example 1 — using — the both sides — the resin insulating layer between layers, and a conductor — the circuit manufactured the substrate by which laminating formation was carried out.

(2) next, the conductor of the outermost layer — the photo detector and the light emitting device were attached in the position of a circuit through electroconductive glue. In addition, as a photo detector and a light emitting device, the same thing as an example 1 was used.

(3) Next, the solder resist constituent was prepared using the same approach as the process of (15) of an example 1. furthermore, the process of the above (2) — a conductor — after sticking a resist on the light sensing portion and light-emitting part of the photo detector attached in the circuit, and a light emitting device, the above-mentioned solder resist constituent was applied, for 20 minutes was performed at 70 degrees C, desiccation processing was performed the condition for 30 minutes at 70 degrees C, and the layer of a solder REJISU constituent was formed. In addition, the thickness of the above-mentioned photo detector and a light emitting device was 300 micrometers.

[0141] (4) The photo mask with a thickness of 5mm with which the pattern of opening for solder bump formation was drawn was further stuck in the layer of the solder resist constituent by the side of IC chip mounting, exposure and a development were performed on the same conditions as (17) of an example 1, and opening for solder bump formation with a diameter of 200 micrometers was formed. Moreover, opening for solder bump formation as well as the layer of the solder resist constituent by the side of optical element mounting was formed. Next, the resist attached in the light sensing portion and the light-emitting part at the process of the above (3) is removed, the layer of a solder resist constituent was stiffened on the still more nearly same conditions as (17) of an example 1, and while having opening for solder bump formation, and opening for optical paths formed in the part which counters a light sensing portion and a light-emitting part, the optical element formed the solder resist layer laid underground completely. In addition, the thickness by the side of IC chip mounting is 450 micrometers, and the optical element mounting side of the thickness of this solder resist layer is 450 micrometers.

[0142] (4) Next, the enveloping layer (solder pad) was formed in opening for solder bump formation using the same approach as the process of (18) of an example 1.

(5) Next, although a solder bump is formed in opening for solder bump formation, the soldering paste of a complement was printed, and by carrying out a reflow at 250 degrees C, the solder bump was formed and it considered as the substrate for IC chip mounting. By passing through such a process, the substrate for IC chip mounting with which the optical path for which a photo detector and a light emitting device are laid under the field side of 1, and which connects the light sensing portion of this photo detector, the light-emitting part of this light emitting device, and a lightwave signal was both secured was manufactured by this example.

[0143] Thus, after having arranged the end face of an optical fiber in the location which counters the light sensing portion of a photo detector, attaching the detector in the location which counters the light-emitting part of a light emitting device and making a lightwave signal calculate with delivery and IC chip through an optical fiber after that about the substrate for IC chip mounting of the acquired examples 1-3, when the detector detected the lightwave signal, the desired lightwave signal was detectable.

[0144]

[Effect of the Invention] Since it consists of the above-mentioned configuration and the photo detector and the light emitting device are mounted on the surface of the substrate, when IC chip is mounted in this substrate, the substrate for IC chip mounting of the first – the third this invention has a short distance of IC chip and an optic,

and is excellent in the dependability of electrical signal transmission. Moreover, in the substrate for IC chip mounting of the first – the third this invention, since electronic parts and an optic required for optical communication can be unified by mounting IC chip, it can contribute to the miniaturization of the terminal equipment for optical communication.

[0145] Moreover, a solder resist layer is formed in the outermost layer of the side in which the photo detector and the light emitting device are mounted in the substrate for IC chip mounting of the first – the third this invention. When the solder bump is formed in the above-mentioned solder resist layer Since the substrate for IC chip mounting is connectable with an external substrate through this solder bump, The above-mentioned substrate for IC chip mounting can be arranged to a position according to the self-alignment effectiveness which solder has, and an exact lightwave signal can be transmitted between the substrate for IC chip mounting of the first – the third this invention, and an external substrate.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the sectional view showing typically 1 operation gestalt of the substrate for IC chip mounting of the first this invention.
[Drawing 2] It is the sectional view showing typically 1 operation gestalt of the substrate for IC chip mounting of the second this invention.
[Drawing 3] It is the sectional view showing typically 1 operation gestalt of the substrate for IC chip mounting of the third this invention.
[Drawing 4] It is the sectional view showing typically a part of process which manufactures the substrate for IC chip mounting of the first this invention.
[Drawing 5] It is the sectional view showing typically a part of process which manufactures the substrate for IC chip mounting of the first this invention.
[Drawing 6] It is the sectional view showing typically a part of process which manufactures the substrate for IC chip mounting of the first this invention.
[Drawing 7] It is the sectional view showing typically a part of process which manufactures the substrate for IC chip mounting of the first this invention.
[Description of Notations]
20 Substrate for IC Chip Mounting
21 Substrate
22 Resin Insulating Layer between Layers
24 Conductor -- Circuit
27 Bahia Hall
29 Through Hole
31 Opening for Optical Element Mounting
34 Solder Resist Layer
38 Photo Detector
39 Light Emitting Device
120, 220, 320 Substrate for IC chip mounting
121, 221, 321 Substrate
122, 222, 322 Resin insulating layer between layers
124, 224, and 324 a conductor -- circuit
127, 227, 327 Bahia hall
129, 229, 329 Through hole
131, 231, 331 Opening for optical elements
134, 234, 334 Solder resist layer
138, 238, 338 Photo detector
139, 239, 338 Light emitting device
140, 240, 340 IC chip
142, 242, 342 Conductive layer

[Translation done.]